rule out the possibility of a simple rotational interpretation.[13] In addition, we find 5 cases where the excited state spin *exceeds* that of the ground state (the latter being $\frac{3}{2}$ or greater), Ta^{181} being a well-known example, plus 8 cases having ground state spin $\frac{1}{2}$.

We are planning to study the excitation functions of some additional nuclei in this survey in the hope that higher multipole-order contributions might show up as deviations from the theoretical shape predicted for quadrupole excitation.[3]

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A New Spinor Theory of Elementary Particles

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THE usual spinor theory of elementary particles[1] uses spinors of the kind

$$a^{\dot\mu_1\cdots\dot\mu_M}_{\nu_1\cdots\nu_N},\quad b^{\dot\mu_0\dot\mu_1\dot\mu_2\cdots\dot\mu_M}_{\nu_2\cdots\nu_N}$$

which possess dotted and undotted indices. The rank of these spinors is $r=M+N=2s$, where s is the spin of the particle. The spinors obey the generalized Dirac equations:

$$\partial^{\dot\mu_0\nu_1}a^{\dot\mu_1\dot\mu_2\cdots\dot\mu_M}_{\nu_1\nu_2\cdots\nu_N}=i\frac{mc}{\hbar}b^{\dot\mu_0\dot\mu_1\dot\mu_2\cdots\dot\mu_M}_{\nu_2\cdots\nu_N},$$

$$\partial_{\dot\mu_0\nu_1}b^{\dot\mu_0\dot\mu_1\dot\mu_2\cdots\dot\mu_M}_{\nu_2\cdots\nu_N}=i\frac{mc}{\hbar}a^{\dot\mu_1\dot\mu_2\cdots\dot\mu_M}_{\nu_1\nu_2\cdots\nu_N}.$$

These are 2×2^{2s} equations to which must be added the conditions of symmetry for all spinor indices as all spinors used have to be totally symmetric.[1] So the number of independent components is $(M+1)(N+1)$ for the a spinor and $N(M+2)$ for the b-spinor. One can see that the number of all spinor components used, namely $2MN+3N+M+1$, is greater than the number of states of the elementary particle. An elementary particle possesses two degrees of freedom: charge and spin. The charge contains two possibilities, $+e$ and $-e$, and the spin has $2s+1$ possibilities. Measurements made on an elementary particle distinguish, therefore, $2(2s+1)$ different states of a quantized spinor wave field of spin s. It must therefore be possible to describe an elementary particle sufficiently by only $2(2s+1)$ spinor components. As will be seen, this new method[2] has several advantages—for instance any problem can be solved regardless of the value of the spin. Furthermore, bosons and fermions differ only after quantization. So general electromagnetic (or other) interactions[3] or the scattering of particles with spin s by a Coulomb field have to be calculated only once for the spin s and not separately for $s=0$,[4] $s=\frac{1}{2}$,[5] and $s=1$.[6] Furthermore, it might be that the slightly different transformation properties of spinors (*vis à vis* tensors, used now for the description of bosons) give other results[7] for interacting particles.

By multiple application of formulas of the kind

$$\partial_{\dot\mu_M\nu_{N+1}}a^{\dot\mu_1\cdots\dot\mu_{M-1}\dot\mu_M}_{\nu_1\cdots\nu_{N-1}\nu_N}=i\frac{mc}{\hbar}a^{\dot\mu_1\cdots\dot\mu_{M-1}}_{\nu_1\cdots\nu_{N-1}\nu_N\nu_{N+1}},$$

one arrives finally at the spinors $a^{\dot\mu_1\cdots\dot\mu_{2s}}$ and $a_{\nu_1\cdots\nu_{2s}}$ which contain only indices of one kind and exactly $2(2s+1)$ components. These new spinors obey second-order differential equations:

$$(\Box-m^2c^2/\hbar^2)a^{\dot\mu_1\cdots\dot\mu_{2s}}=0,\quad (\Box-m^2c^2/\hbar^2)a_{\nu_1\cdots\nu_{2s}}=0,$$

which describe the propagation of the unquantized spinor wave field. There are no longer any first-order differential equations which, according to Pauli,[8] are not at all necessary.

It is possible to build up a relativistically- and gauge-invariant theory which is also invariant against inversions $x_k\to -x_k$ $(k=1, 2, 3)$, $x_4\to x_4$. After quantization,[9] the new theory reproduces for the free particle the well-known results of the usual theory[10] in a generalized manner, so that, for instance, the whole charge Q or the whole energy H is given by:

$$Q_{B,F}=e\sum_{r,k}^{\infty}(\mathfrak{N}^{(+)}{}_{r,k}{}^{B,F}-\mathfrak{N}^{(-)}{}_{r,k}{}^{B,F}),$$

$$H_B=\sum_{k,r}^{\infty}E_k(\mathfrak{N}^{(-)}{}_{k,r}{}^{B}+\mathfrak{N}^{(+)}{}_{k,r}{}^{B})+\sum_{k}^{\infty}E_k,$$

$$H_F=\sum_{k,r}^{\infty}|E_k|\,\mathfrak{N}^{(-)}{}_{k,r}{}^{F}+\sum_{k,r}^{\infty}|E_k|\,\mathfrak{N}^{(+)}{}_{k,r}{}^{F},$$

where B, F means boson *or* fermion, where $\hbar k$ is the momentum and r the spin number $r=0\cdots 2s+1$. The matrices $\mathfrak{N}^{(+)}{}_{r,k}{}^{B,F}$, $\mathfrak{N}^{(-)}{}_{k,r}{}^{B,F}$ are the well-known diagonalized matrices with infinite rows for bosons and with two rows for particles subject to the Pauli principle (fermions), depending on k and r and giving the number of particles present. Besides the possibility of giving other results for interacting particles, the new theory has the advantage of being a consistent general theory without superfluous components or accessory conditions, able to give the basis for a proposed unified nonlinear spinor theory of all elementary particles.[11]

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